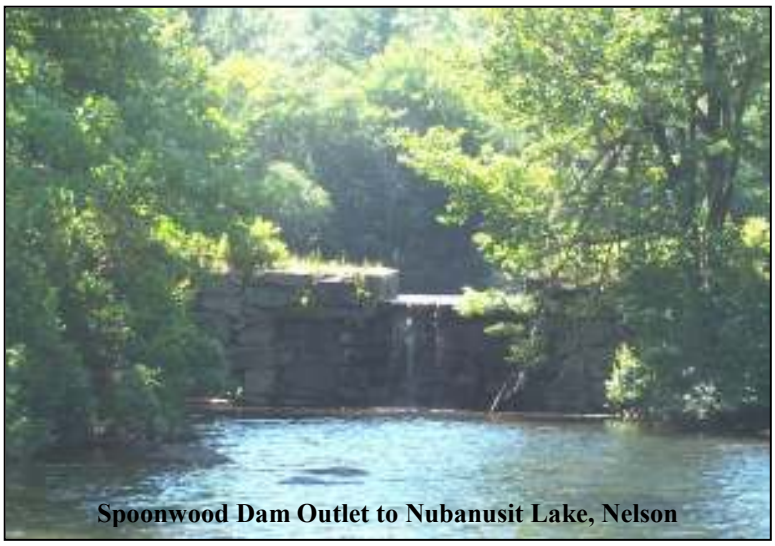
Lake Drawdowns: Friend or Foe?

A Brief History of New Hampshire's Dams

New Hampshire has over 4,800 dams statewide, many of which were constructed over a century ago. Dams were integral to economic growth in New Hampshire. Over time the purpose and function of these dams has changed, however they are an essential part of our landscape.



Spoonwood Dam Outlet to Nubanusit Lake, Nelson

In the eighteenth century, settlers constructed the first dams to power grist and lumber mills downstream. During the winter months settlers needed a method to store and access water; dams provided the solution. As time passed, dams were used by a growing number of manufacturers to advance the industrial revolution. When logging was at its peak, dams were constructed between forests and downriver sawmills to offer temporary storage. These early dams are among the oldest and largest engineering schemes still in operation in New Hampshire.

After the devastating flood of 1927, many dams were constructed to provide flood control. Overtime, the flow of water from dammed areas was harnessed for other purposes, such as hydroelectric power, water supply, further flood control, and recreational purposes. Dams also created habitats for many fish and wildlife species, and a water supply source to communities.

The most common dam structure found throughout New Hampshire is the earthen embankment dam. The earthen embankment dam is constructed using earth or rock fill, and is dependent upon some form of concrete, stone, or timber spillway section. The dam relies on its own weight and the characteristics of built materials to maintain a steady seepage for its stability.

Other commonly used dam structures in New Hampshire are gravity dams constructed of concrete or masonry, such as stone or brick, which typically have a spillway. Buttress dams characteristically consist of a wall or arch supported by several buttresses spaced across the downstream side of the dam.

What is Lake Drawdown?

Lake drawdown is the seasonal (typically fall in New Hampshire) lowering of a body of water and is normally achieved by removing stop logs to increasing water flow from the dams. The technique originated when settlers wanted to control the amount of water

released downstream to power mills. The practice also helped to maintain water flow during seasonal changes in precipitation and water level.

Lake drawdowns are often conducted for the same reasons today, and benefits often include reduced shoreline erosion, aquatic plant control, reduced adverse effects of winter ice damage, and increased water storage capacity to reduce spring flooding.

Drawdowns of New Hampshire public waters are regulated by the New Hampshire Department of Environmental Services (DES) Dam Bureau to ensure that the drawdown is in the best interest of all parties affected.

How does drawdown reduce shoreline erosion?
Shoreline erosion is a natural and continuous process. High water conditions can have irreparable effects on the shoreline if water levels are above normal. The force applied by lake water and soil saturation will gradually erode the shoreline. Wave action caused by high winds or boating activity can also erode the shoreline above the normal water line. However, there are ways to mitigate and slow the erosive process.

By lowering water levels, erosive forces of waves are reduced and only occur below the normal water level protecting the shoreline from high waters and erosion. Drawdowns also provide a vertical space for water levels to rise; often as a result of spring runoff and precipitation, allowing water levels to return to normal heights.

How can drawdown help control aquatic plant growth?
Aquatic plants are commonly found along the water's edge and are beneficial to the aquatic ecosystem. The vegetation provides habitat and food for a variety of wildlife (including fish), filters out pollutants and nutrients from surface runoff, and stabilizes banks to prevent shoreline erosion. High abundances of native and exotic aquatic plants can often be considered a nuisance by property owners, swimmers and boaters.

Drawdowns are used as a low cost and toxic free mechanism of potentially reducing exotic and native plant infestations. The objective is sediment exposure resulting in desiccation of root systems during late fall ground freezes. The freezing is intended to damage or kill root systems and seeds to reduce or eliminate some plant species. Some aquatic vegetation is not easily controlled by the drawdowns. There are several annual aquatic species that produce seeds, and free-floating plants that are not effectively managed by drawdown.

Aquatic plant management success is related to the frost depth and sediment dewatering. Rooted vegetation may be exposed to freezing temperatures; however an adequate frost depth may not be achieved, thus not successfully impacting seed bases and root systems.

How do drawdowns reduce adverse impacts to lake structures?
Once a lake or pond has frozen, the thickness of the ice can reach a depth of two or more feet. Eventually, the ice can exert a hefty force upon the shoreline or associated structures, moving or damaging objects in its path. Lake drawdown can combat the effects of these forces by re-directing where the pressure is exerted. This allows the natural shoreline and nearby structures to remain unaltered or disturbed.

The exposure of the shoreline during the fall months also allows property owners to carry out required minimum impact maintenance or repairs to their property. Some maintenance requires a Wetlands Permit so be sure to consult with the DES Wetlands Bureau before taking on large projects.

How do drawdowns reduce flooding?
Spring snowmelt and precipitation, depending upon the rate at which both occur, can ultimately raise lake and pond water levels. In recent years, the state has experienced severe storm events that have caused extensive flooding. The ability of lakes and ponds to store this excess water is crucial.

Fall drawdowns provide extra storage capacity for lakes and ponds during spring run-off events. This in turn can help reduce shoreline erosion and property damage due to flooding, and can reduce potential downstream flooding.

If the spring is arid and lakes and ponds do not return to normal water levels, multiple problems can result. The key is to maintain meticulous control over the water outflow of the pond, a responsibility of dam management.

How do drawdowns affect aquatic species populations?
Lake drawdowns may cause sudden changes in aquatic ecosystems and shoreline habitats. Fish and waterfowl populations may experience shortages in food sources. Amphibians and benthic invertebrates may exhibit changes in species abundance or composition. Species, such as snails and mussels that are unable to travel quickly, may not move fast enough to keep up with the receding waters resulting in mortality through desiccation or competition as a food source. Most drawdowns are controlled and occur slowly, but no drawdown can be free of species and habitat destruction.

How do drawdowns impact suspended sediments and nutrients?
Water volumes increase downstream during drawdowns. Even though the flows are temporary, if water is released too quickly it can cause concern both downstream and in upstream wetlands. The same environmental impacts that occur in the lake also occur in any upstream wetland. These wetland areas contain complicated food webs and a series of different inhabitants that must struggle with each drawdown. Although drawdowns are closely monitored to prevent major disturbances to the waterbody, little attention is provided for the many upland wetlands.

Drawdowns increase nutrient and sediment loading downstream. At the conclusion of fall lake turnover, nutrients typically confined to the hypolimnetic waters are mixed into one isothermal water layer. The potential for short-term algal or cyanobacteria blooms increase both in the lake and downstream waterbodies. High algal cell populations may also lead to dissolved oxygen depletion in downstream waterbodies. If drawdown occurs too quickly, the increased water flow and energy enhances the probability of bank erosion. The suspended sediments will increase turbidity and smother the benthic environments that support aquatic biota.

A Case Study at Ashuelot Pond, Washington
Ashuelot Pond in Washington, N.H., has a history of lake drawdown. Since the mid-1980s Ashuelot has been drawn down in an attempt to control aquatic vegetation, specifically native plant populations. In 1991, DES regulated annual drawdowns to 3.5

feet for flood control, and deep drawdowns to take place every fifth year. The DES Biology Section researched the physical, chemical, biological and ecological impacts of drawdowns to Ashuelot Pond. The study focused on impacts of drawdowns on aquatic plant percent cover, aquatic biota, and overall water quality. The results are as follows.

Throughout Ashuelot Pond the general aquatic plant percent cover did not illustrate a statistically significant change. When the results were more closely examined, only a few aquatic plant populations showed weakly significant changes. Only one species, Pondweed, had a definitive statistical decrease in the water body. In 2005, the Ashuelot River downstream of the dam, presented a small but statistically significant increase in overall aquatic plant cover compared to the data sets from 2002, 2003 and 2004.

Deep drawdowns and shallower drawdowns were compared to determine effects on macroinvertebrates (small bugs lacking a backbone that are a food source for fish). The overall number of macroinvertebrates did not significantly increase or decrease after the drawdowns. The deep drawdown did not impact species population however there was an impact on species diversity. The dominant macroinvertebrate species shifted from Dipterans (example: black fly, mayfly, or stonefly) to Amphipods (a species of shrimp-like crustaceans) after the deep drawdown.

One interesting observation by biologists is that no freshwater mussels were observed on the lake bottom or on the shoreline during the study period. It is not know if this is a natural condition of the lake of if continuous drawdowns may eliminate freshwater mussels from the lake biota.

The frog population was not adversely affected by the deep drawdowns. Statistical analysis of the data concluded the frog populations were rather stable in the pond. It is evident that adult frogs continued reproducing and egg masses were observed throughout the study.

Fish populations are measured by the Proportional Stock Density (PSD), which is a value used to describe the structural balance of a fish population. The PSD of largemouth bass in Ashuelot Pond has been variable over time. The weights of large mouth bass were found to have no significant difference among years, which suggests the drawdown had no direct impact on the largemouth bass population.

The study of Ashuelot Pond provided a thorough assessment of New Hampshire lake drawdown affects on the aquatic ecosystem. Drawdowns do not yield dramatic declines in aquatic plant abundance or diversity suggesting that drawdowns are not successful tools in reducing the overall aquatic plant percent cover in a pond. Drawdowns do, however, exert some negative pressures on aquatic organisms. The conclusion for Ashuelot Pond is to protect the integrity of the aquatic ecosystem; deep water drawdowns are not the best method to control aquatic plant growth.

Who to Contact

For more information relative to the design, construction, maintenance and operation of dams, please contact the DES Water Division Dam Bureau at (603) 271-3406 or email mdamsafety@des.state.nh.us. General information is available at

www.des.nh.gov/Dam/. You may also visit our office at 29 Hazen Drive in Concord, New Hampshire.

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Types of Dams Common to New Hampshire, WD-DB-2, DES Fact Sheet, (603)271-3503 or http://des.nh.gov/organization/commissioner/pip/factsheets/db/documents/db-2.pdf

Why Lake Drawdowns Are Conducted, WD-DB-16, DES Fact Sheet, (603) 271-3406 or http://des.nh.gov/organization/commissioner/pip/factsheets/db/documents/db-16.pdf